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Apparatus and Method for Rehabilitation with an emphasis on retraining Balance and Proprioception.

Background of the Invention

The present invention relates to an apparatus and method for assisting in rehabilitation of injured ankles.

There are many devices on the market today that focus on the rehabilitation of the ankle. Most all of these devices have a flat surface to meet the foot, and a curved lower surface contacting the floor. One such device is found in U.S. Patent No. 5,722,919issued to Timmer on March 3, 1998. Timmer teaches a foot plate with a moveable weight attached to the bottom, such that the patient can strengthen the ankle by adding weight or moving the location of the weight. As an alternative, the weight is replaced with a semi-spherical ball, the flat portion of which abuts the bottom of the foot plate. The semi-spherical ball has a constant radius in all directions: therefore, a patient using this device will move the ankle with the same radius of curvature no matter the direction of movement. For example, a plantar flexion/dorsiflexion exercise, characterized by front to back motion of the ankle, is performed along the same radius of curvature as an inversion/eversion exercise, which is characterized by side to side rotation of the ankle. This limitation is inherent in the nature of the semi-spherical ball, which provides for the same radius of curvature for a motion in any direction.

Most all balance boards fall into this same category. The other limitation to the devices in this family of rehabilitation device is the material with which they are made. Most all balance boards are made of either plastics or wood. This makes balance boards almost impossible to maintain balance on when placing a patient's full amount of weight onto the device. There is no give or compression to these products. Therefore, there is no true feedback which is vital to the retraining of the injured receptors. Since the balance boards do not give or compress down slightly, there is only a small surface of the semi-spherical ball coming into contact with the floor,

or second surface. This makes the pivot point extremely unstable. Imagine trying to balance while standing on a piece of flat hardwood while on top of a large metal ball. This would be similar to the same amount of difficulty. In order to retrain important mechanoreceptors found in the ankle, they need a longer amount of trial time in that challenging position to receive true benefit. The balance boards do not provide the patient or individual with enough balance position time to rehabilitate the injured extremity in single leg stance of gait. They must always place both feet on the device at the same time to assist in the balance retraining of this device. This is not functional by any means. The proper way to retrain someone is the way they function in their lives. Most all humans, during ambulation, are able to propel themselves by going to a single leg stance. Then pushing off one leg (stance phase) and placing the other leg, (which at the time was in the swing phase of gait) to contact the floor in single leg stance phase. Therefore, the other limitation to these devices are that most individuals must retrain with both feet on the device. Humans do not hop on both feet where we are going, so why train with both feet on the object at the same time. This is not functional and demonstrates another limitation to the devices in this category.

Another exercise device falling into the latter of the two categories is found in U.S. Patent No. 5,643,164 issued to Teff on July 1, 1997. Teff teaches a rocker board, the bottom of which contains two arc shaped members. The patient stands on the rocker board aligning the feet such that they are either parallel to the arched members or perpendicular to them. An obvious limitation to this device is that the patient who is engaging in a plantar flexion/ dorsiflexion exercise must re-orient the feet 90 degrees to perform an inversion/ eversion exercise. Unlike the semi-spherical ball disclosed in Timmer, movement of the rocker board also has a single fixed radius of curvature that forces the patient to use the same pivotal motion for each exercise. This device does not allow for the retraining of tri-planar motion. Tri-planar motion is vital at the ankle, since it is a joint that functions with 360 degrees of movement.

Two other limitations to both groups of rehabilitative devices mentioned above are their size and weight. Most balance boards measure 20" to 30 " in diameter. In addition, they weigh anywhere from 5 lbs. or more.

Accordingly, it is desirable to provide a neuromuscular/proprioceptive rehabilitation apparatus, which overcome the above referenced limitations

by providing better design, proper material (foam), size and weight decrease to achieve your goals of rehabilitation.

Summary of the Invention

Therefore, it is an object of the invention to provide an improved neuromuscular/proprioceptive apparatus having the proper range of motion and allowance of stance (training) time to be improved thus enabling the individual to return to full functional abilities. By doing so, retraining the important receptors of the body, which detect positioning of the joints in space and in turn protecting the joints from possible future injury.

It is another object of the present invention to provide a neuromuscular/proprioceptive apparatus that is light weight with small dimensions and easy to take home for training continuation.

It is another object of the present device to provide accommodation such as compression, by the use of foam, to retrain the injured joint in a similar fashion as they would normally encounter. This would be similar to the foot accommodating a shoe. Most ankle sprains occur while a person is wearing a shoe. The importance being to retrain the way you function.

It is another object of the present device to provide an apparatus which allows retraining in single leg stance.

In another aspect of the present invention, an exercise apparatus is provided which is comprised of polyethylene foam. It is specific and unique that the density of the foam is 3 lbs. per cubic foot. This specific density allows for the correct compression of the device despite the weight of the individual standing on the device. By having the compression and accommodation to the contacting surface (floor), you allow for true stance time on a single leg for a training benefit to be achieved. The compression allows the uniqueness of training in a single stance phase of gait with proper stance time. The compression of this specific density of foam allows for a method of increasing proprioception. Compression in this sense being, when the weight of the individual is placed on the apparatus in a single leg stance the thickness is decreased. The decrease of the thickness and compression of the foam allows for an increased surface contact of the convex surface with a second surface making it more stable. The increased stability due to increased surface contact allows the patient to be able to truly keep their balance, thus increasing their stance time. This is unique to the balance

boards and other devices, in that they do not compress, and surface contact is minimal making the device so unstable correct training time can not be accomplished.

In another aspect of the present invention, an exercise apparatus comprised of foam at this specific density of 3 lbs. per cubic foot, allows for a light weight portable device weighing merely 2.8 ounces. Thus, allowing easier transfer to home exercises for rehabilitation.

It is another aspect of the present invention, an exercise apparatus have the exact dimensions of 13.5 inches in length x 6 inches in width, intended to receive the patient's extremity. It is these flat surface dimensions will allow the patient to place a single extremity on the apparatus and retrain in a functional stance phase of gait. The foam structure is made from a one piece construction, with a flat surface to contact the injured extremity, and a convex side to create a challenging surface allowing for pivotal movement of the joint, which changes the position of the contact point to allow for movement in any direction.

A thickness is defined as the distance from the first surface to the second surface measured along a line approximately normal to the first surface and passing through the intersection of the major and minor diameters, where the length of the major diameter is 13.5 inches, the width of the minor diameter is 6.0 inches, and the thickness is 3.0 inches. The thickness of the apparatus is unique in its' design due to the fact that it allows correct tri-planar motion at the ankle. In turn, normal range of motion can be performed with this thickness. Due to the exact thickness of the apparatus, normal plantar flexion of the ankle is achievable at 50 degrees. Also, normal dorsiflexion of the ankle is achievable at 20 degrees. Normal range of motion of both inversion and eversion is also available with this proper thickness.